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POST STABILIZATION ESTIMATES OF MONEY DEMAND IN CROATIA: THE ROLE OF THE EXCHANGE RATE AND CURRENCY SUBSTITUTION[1]

Autor ocjenjuje ulogu tečaja i valutne supstitucije u funkciji potražnje za novcem u poststabilizacijskom razdoblju za hrvatsko gospodarstvo. Tri različita monetarna agregata, kamatne stope i inflacija pokazali su se statistički nesignifikantnima; ipak, rezultati sugeriraju da je tečaj signifikantan i da ima negativan utjecaj na potražnju za novcem. Ako domaća valuta deprecira, pojedinci će biti skloni supstituirati domaću valutu stranom. Testovi strukturne stabilnosti pokazuju da su ocijenjene funkcije potražnje za novcem stabilne.

Introduction

One of the centerpieces of macroeconomic models has been the demand for money and the stability of this relationship. There has been an enormous amount of research on the estimation of a stable money demand function with respect to various economies, different monetary aggregates, as well as varying methodological approaches. The task of this paper is a rather straightforward and hopefully simple one of providing estimates of the demand for various monetary aggregates in the case of Croatia since the anti-inflation stabilization program of October 1993. Indeed, the success of the stabilization program essentially introduced a shift towards a economic regime in which the price level has been relatively stable.

Section II will briefly outline Croatia's transition to a market-oriented economy in terms of the behavior of the demand for money. Section III describes

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the data, real partial adjustment money demand specification along with empirical results. Section IV provides concluding remarks.

Croatia's Transition and the Behavior of Money Demand

Croatia inherited an inflationary environment from the former Yugoslavia when declaring independence in 1991. The war with Serbia and Montenegro added to the inflationary pressures as monetization of fiscal deficits were required to finance the war as well as provide aid to the refugees. As one might guess with inflation averaging between 20 and 40 percent per month, the demand for real money balances declined in part due to the presence of inflation and currency substitution.

On October 4, 1993, the Croatian anti-inflation stabilization program was introduced. The program essentially relied upon a combination of orthodox and heterodox policy anchors: implementation of a restrictive monetary policy, liberalization of the foreign exchange market and exchange rate, control of public sector wage growth, realignment of the prices of public utilities in order to eliminate losses, and the passage of a balanced budget (Anušić, et.al. 1995). The program was successful with deflation occurring in November 1993. Indeed, the stabilization program changed the behavior of money demand via the reduction in expected inflation along with the appreciation of the nominal and real exchange rates. As a result of the reduction in inflation and appreciation of the exchange rate, households began to replace their foreign exchange savings with domestic currency (i.e. reverse currency substitution) which, in turn, increased the demand for real money balances.

Thus, in light of the behavior of real money balances resulting from the stabilization program, the task of this paper is to provide estimates of real money demand over the post-stabilization period. Although there has been some work on money demand in Croatia, the time horizon of these studies have been relatively short, concentrating upon the pre-stabilization and very early post-stabilization periods (Anušić, 1994; Anušić, et. al., 1995, Babić, 1998). However, one limitation of the analysis is the availability of reliable and sufficient time series data to undertake more advanced econometric approaches.[2] Thus, this paper can be viewed as a complement to the previous work on the estimation of the demand for real money balances in Croatia. Therefore, the analysis will proceed by investigating real money balances using a short-run real partial adjustment money demand specification.

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[2] The cointegration methodology has been extensively used in the recent money demand literature (see Hoffman and Rasche, 1996 and citations therein). Cointegration analysis allows one to examine long-run elasticities with respect to income and interest rates as well as the model's short-run dynamics and test for the model's stability. However, the cointegration methodology needs a relatively longtime horizon. In this regard see Hakkio and Rush (1991).

Data, Specification, and Results

Quarterly data is used over the post-stabilization period, 1994:1 to 1999:4, as compiled by the Institute of Economics, Zagreb. The definitions of the variables are outlined in Appendix A. The traditional closed-economy money demand specification includes as its determinants a scale variable and domestic opportunity cost variables (Judd and Scadding, 1982 and Laidler, 1985). However, in the context of an open economy Mundell (1963) posited that money demand may be influenced by exchange rate movements in addition to the interest rate and the level of income. Indeed, the traditional money demand specification omitting the effects of currency substitution may result in its instability and reduce the effectiveness of monetary policy.[3]

A number of studies have examined the effects of currency substitution for industrialized and developing economies. However, the study of currency substitution on money demand and the stability of money demand has not been explicitly undertaken for transition economies. The impact of currency substitution is especially relevant for transition economies given the lack of adequate domestic financial assets in which to hold wealth and the uncertainty associated with structural reform policies. As discussed by Cuddington (1983), the "pegging" of exchange rates as is often the case in the early phases of transition do not eliminate the importance of currency substitution, especially if individuals do not have complete confidence in the maintenance of the official exchange rate policy. As Tanzi and Blejer (1982) discuss even countries which impose capital and exchange controls, must recognize the emergence of black markets in which currency substitution effects will exist. In the case of Croatia, Šonje and Vujčić (1999) point out that approximately 80 percent of savings is held in foreign exchange deposits with such deposits comprising a 60 to 70 percent share of broadly defined money, much higher than other transition economies. Šonje and Vujčić (1999) further allude to the importance of the exchange rate as an opportunity cost variable in money demand.

In the context of money demand, Cuddington (1983) suggests that domestic residents can choose to hold their wealth in the form of four basic assets: domestic money, foreign money, domestic currency-denominated interest bearing assets (domestic bonds), and foreign currency-denominated interest bearing assets (foreign bonds). Capital mobility effects occur when individuals switch between domestic and foreign non-monetary financial assets whereas currency substitution effects occur when individuals switch between domestic and foreign fiat money. Arango and Nadiri (1981), Brittain (1981), Ortiz (1983), Cuddington (1983), Ahking (1984), Joines (1985), Darrat (1986), Arize (1989), Rogers (1992), Leventakis (1993), Arize (1994), Chowdhury (1995), Darrat and Al-Mutawa (1996), Gruben and Welch

[3] Miles (1978), Girton and Roper (1981), McKinnon (1982), and Cuddington (1983) set forth the analysis of the effects of capital mobility and currency substitution in the context of monetary policy effectiveness.

(1996), Weliwita and Ekankyake (1998), and Khalid (1999) incorporate foreign interest rate and exchange rate variables to examine the effects of capital mobility and currency substitution on the demand for money. On the other hand, Hamburger (1977), Bordo and Choudhri (1982), Brissimis and Leventakis (1985), Fasano-Filho (1986), Marquez (1987), Domowitz and Elbadawi (1987), Ghosh (1989), Viren (1990), Bahmani-Oskooee and Pourheydarian (1990), Bahmani-Oskooee (1991), Bahmani-Oskooee and Malixi (1991), Karfakis (1991), McNown and Wallace (1992), Arize and Shwiff (1993), Karfakis and Parikh (1993), Bahmani-Oskooee and Rhee (1994), Elysiani and Zadeh (1995, 1999), Darrat, et.al. (1996), Bahmani-Oskooee and Shabsigh (1996), Bahmani-Oskooee, et.al. (1998), and Ewing and Payne (1999) test solely for currency substitution by excluding the foreign interest rate variable in the real money balances specification. There are several reasons cited for the omission of the foreign interest rate. First, the integration of global financial markets and the international arbitrage often result in the equalization of interest rates in different currencies, known as the interest rate parity condition in international finance. Second, studies which include both foreign and domestic interest rates in the money demand specification encounter severe multicollinearity problems.

Given our focus on the demand for money by domestic residents we postulate the following real partial adjustment model of money demand: $\ln(M/P)_t = \beta_0 + \beta_1 \ln y_t + \beta_2 \ln_t + \beta_3 \ln(P/P_{t-1}) + \beta_4 \ln er_t + \beta_5 \ln(M/P)_t + \varepsilon_t$ where $\beta_1 > 0, \beta_2 < 0, \beta_3 > 0, \beta_4 <> 0, \beta_5 > 0$; $\ln(M/P)_t$ is the natural logarithm of real money balances based on M1, M1A, or M4; lnyt is a scale variable measured by the natural logarithm of real GDP; $\ln i_t$ is the natural logarithm of the nominal interest rate on bank deposits; $\ln(P/P^{t-1})$ is the rate of inflation; lnert is the natural logarithm of the effective exchange rate either in nominal or real terms; and $\ln(M/P)^{t-1}$ measures the adjustment process from actual to desired real money balance holdings.[4] As in the case of traditional money demand studies, the demand for real money balances is positively related to the scale variable, $\ln y_t$. The interest rate, $\ln i_t$, has a negative effect on the demand for domestic real balances. Inflation, $\ln(P/P^{t-1})$, measuring the return on physical (real) assets, is negatively related to domestic real money balances. The exchange rate, $\ln er_t$, may affect the demand for domestic money several ways. An expected depreciation of the domestic currency will induce both domestic and foreign residents to substitute away from domestic money towards foreign money, known as the currency substitution effect, $\beta_4 < 0$. However, Bahmani-Oskooee and Pourheydarian (1990) demonstrate in an open economy Keynesian macro-model that the coefficient, β^4, on the exchange rate variable may be negative or positive. For instance, an expansionary monetary policy leads

[4] Studies by Bahmani-Oskooee and Pourheydarian (1990), Bahmani-Oskooee (1991), Bahmani-Oskooee and Malixi (1991), Arize and Shiff (1993), Weliwita and Ekanayake (1998), and Elysiani and Zadeh (1999) use the real effective exchange rate while Bahmani-Oskooee and Rhee (1994) use both nominal and real effective exchange rate. The other studies cited use the nominal effective exchange rate.

to a depreciation of the domestic currency. If individuals have formulated expectations of an appreciation, the demand for the domestic currency will increase, $\beta_4 > 0$; on the other hand, if individuals formulated expectations of further depreciation, the demand for the domestic currency will decrease, $\beta_4 < 0$.

Panel A of Table 1 reports the results of estimating equation (1) for M1 real money balances. Specifications (1) and (2) differ in terms of using the nominal and real exchange rate. Real income is statistically significant with the income elasticity of M1 real money demand not statistically different from one. Although the interest rate and inflation variables have the correct sign each is statistically insignificant. The statistical insignificance of inflation is not surprising given the relatively stable price level over the post-stabilization period. However, the exchange rate, measured by either the nominal or real exchange rate suggests that as the domestic currency depreciates there is a decrease in the demand for the domestic currency. Lagged M1 real money balances is positive and statistically significant. The regression model diagnostics are favorable with the overall F--statistic significant. Moreover, the residuals of the estimated models appear free of autocorrelation and heteroscedasticity as well as being normally distributed.

Panel B of Table 1 presents the results of estimating equation (1) for M1A real money balances. Again, as in Panel A, specifications (1) and (2) differ in terms of using the nominal and real exchange rate. Real income is statistically significant, however, in comparison to M1, the income elasticity of M1A real money balances is greater in absolute magnitude yet not statistically different from one. The interest rate has the correct sign but insignificant while inflation has the incorrect sign and insignificant as well. The coefficient on the nominal exchange rate is negative and significant whereas the coefficient on the real exchange rate is negative but insignificant. Lagged M1A real money balances is positive and statistically significant as in the case of M1 but with a smaller coefficient on lagged real money balances, suggesting a slower adjustment to desired real money balance holdings. Again, the regression model diagnostics are favorable with the overall F-statistic significant along with normally distributed residuals free of autocorrelation and heteroscedasticity.

Panel C of Table 1 displays the results of estimating equation (1) for M4 real money balances. Again, as in Panels A and B, specifications (1) and (2) differ in terms of using the nominal and real exchange rate. However, unlike the results for M1 and M1A, real income is statistically insignificant. The interest rate and inflation variables have the correct signs but are again insignificant. Both the nominal and real exchange rates have the correct sign and are significant along with lagged M4 real money balances. As pointed out by Šonje and Vujčić (1999), the sole significance of the exchange rate measures in the broad measure of money is not surprising given the relatively large size of the foreign currency deposits component in M4. Again, the regression model diagnostics are favorable with the overall F--statistic significant with normally distributed residuals free of autocorrelation and heteroscedasticity. However, the presence of many of the independent variables

having low t-statistics in conjunction with very high overall F-statistics suggests that multicollinearity may be an issue for the interpretation of the individual coefficient estimates. Appendix B reports the correlation matrices of the variables associated with the three specifications. With the exception of real income and real money balances having high correlation coefficients between .89 to .93, and the obviously high correlation (.9633) between nominal and real exchange rates, the correlations between the other variables are not unusally large, especially for time series data.

Next, we investigate the stability of the estimated money demand equations over the post-stabilization period using the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) of the recursive residuals tests for structural stability advanced by Brown, et.al. (1975). The cumulative sum test is useful for detecting systematic changes in the regression coefficients whereas the cumulative sum of squares test is useful in situations where the departure from the constancy of the regression coefficients is rather abrupt and sudden. Figures 1-5 plot the respective CUSUM statistics along with a pair of lines representing the 5 percent level of significance while Figures 2-6 plot the respective CUSUMSQ statistics for the money demand equations using the nominal exchange rate.[5] The estimated money demand functions appear stable with neither the CUSUM nor CUSUMSQ test statistics exceeding the bounds of the 5 percent level of significance.

Finally, Figures 7-9 display the actual and predicted values of real money balances for each of the monetary aggregates. Both M1 and M1A display similar patterns with a gradual increase in real money balances after the anti-inflationary stabilization program, leveling off in mid 1997. M4 exhibits a more dramatic rise than either M1 or M1A following the stabilization program, again leveling off in mid 1997. Not surprising given the relatively large overall F-statistics that the estimated money demand equations do well in tracking the behavior of the respective real monetary aggregates.

Concluding Remarks

This paper provides estimates of the role of the exchange rate and currency substitution in money demand over the post-stabilization period (1994:1 to 1999:4) of the Croatian economy. Real income exhibits unit income elasticity for M1 and M1A money demand functions, but is insiginificant in M4 money demand function. Although interest rates and inflation are insignificant across the money demand functions estimated for the three monetary aggregates, the exchange rate is significant and has a negative impact on money demand. Thus, as the domestic currency

[5] The CUSUM and CUSUMSQ test statistics based on the money demand equations using the real exchange rate yield comparable results. In order to conserve space the CUSUM and CUSUMSQ plots are available upon request from the author.

depreciates the demand for domestic money declines. These findings suggest that a relevant opportunity cost variable in the holding of the Croatian kuna is the exchange rate. Therefore, money demand specifications omitting the role of the exchange rate may be misspecified. Given the importance of a stable money demand relationship for the conduct of monetary policy, the cumulative sum and cumulative sum of squares stability tests were conducted. The cumulative sum and the cumulative sum of squares tests of structural stability suggest the estimated money demand functions are stable.

Future research in this area is encouraged on several fronts. First, researchers may investigate the impact of other variables as relevant domestic opportunity cost measures. Second, as more data become available and the Croatian economy settles into a more market-oriented economic system, elaborate time series techniques such as cointegration and error-correction modeling can be undertaken in order to understand the short-run and long-run dynamics.

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Table 1

REAL PARTIAL ADJUSTMENT MODEL OF MONEY DEMAND
(Standard Errors in Parentheses and p-Values in Brackets)

Panel A: M1 Money Demand

(1) Constant	lny_t	lni_t	$ln(P/P_{t-1})$	$lnnex_t$	$lnrex_t$	$ln(M/P)_{t-1}$
-1.05	1.01	-.087	-1.65	-.523		.606
(2.69)	(.209)[a]	(.079)	(1.32)	(.229)[b]		(.077)[a]
$Adj.R^2$ = .971	F = 147.76 [.000][a]	DH = -.263 [.792]	HET = 1.29 [.257]		NOR = 2.28 [.320]	
(2) Constant	lny_t	lni_t	$ln(P/P_{t-1})$	$lnnex_t$	$lnrex_t$	$ln(M/P)_{t-1}$
-4.51	1.02	-.054	-1.68		-.532	.603
(1.87)[b]	(.219)[a]	(.078)	(1.39)		(.289)[c]	(.081)[a]
$Adj.R^2$ = .968	F = 135.42 [.000][a]	DH = -.184 [.854]	HET = 1.08 [.298]		NOR = 2.16 [.340]	

Panel B: M1A Money Demand

(1) Constant	lny_t	lni_t	$ln(P/P_{t-1})$	$lnnex_t$	$lnrex_t$	$ln(M/P)_{t-1}$
-2.22	1.26	-.153	-.227	-.485		.431
(3.15)	(.245)[a]	(.095)	(1.67)	(.275)[c]		(.095)[a]
$Adj.R^2$ = .952	F = 87.35 [.000][a]	DH = -.149 [.881]	HET = .788 [.375]		NOR = 1.65 [.432]	
(2) Constant	lny_t	lni_t	$ln(P/P_{t-1})$	$lnnex^t$	$lnrex^t$	$ln(M/P)^{t-1}$
-5.52	1.25	-.120	-.248		-.463	.426
(2.14)[a]	(.255)[a]	(.093)	(1.70)		(.342)	(.098)[a]
$Adj.R^2$ = .948	F = 81.59 [.000][a]	DH = .030 [.976]	HET = .715 [.398]		NOR = 1.71 [.424]	

Notes: F is the overall F-statistic. DH is the Durbin h statistic to test for autocorrelation. HET is a LaGrange Multiplier test for heteroscedasticity based on teh regression of the squared residuals on squared fitted values, distributed as χ^2_1. NOR is the Bera-Jarque test for normality of the residuals, distributed as χ^2_2. Significance levels are denoted as follows: a (1%), b (5%), and c(10%).

Table 1 (continued)

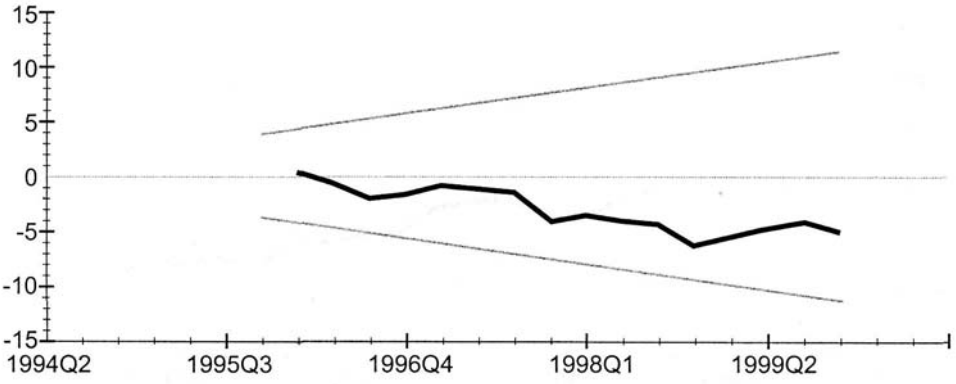
Panel C: M4 Money Demand

(1) Constant	lny_t	lni_t	$ln(P/P_{t-1})$	$lnnex_t$	$lnrex_t$	$ln(M/P)_{t-1}$
3.11	.287	-.056	-1.72	-.457		.904
(3.26)	(.208)	(.076)	(1.18)	(.244)[c]		(.050)[a]
$Adj.R^2$ = .991	F = 486.32 [.000][a]	DH= -.831 [.406]	HET = .826 [.363]		NOR = .527 [.768]	
(2) Constant	lny_t	lni_t	$ln(P/P_{t-1})$	$lnnex_t$	$lnrex_t$	$ln(M/P)_{t-1}$
.492	.280	-.034	-1.91		-.570	.910
(2.21)	(.208)	(.072)	(1.21)		(.303)[c]	(.052)[a]
$Adj.R^2$ = .991	F = 487.13 [.000][a]	DH= -.968 [.333]	HET = 1.40 [.237]		NOR = .645 [.724]	

Notes: F is the overall F-statistic. DH is the Durbin h statistic to test for autocorrelation. HET is a LaGrange Multiplier test for heteroscedasticity based on teh regression of the squared residuals on squared fitted values, distributed as χ^2_1. NOR is the Bera-Jarque test for normality of the residuals, distributed as χ^2_2. Significance levels are denoted as follows: a (1%), b (5%), and c(10%).

Figure 1

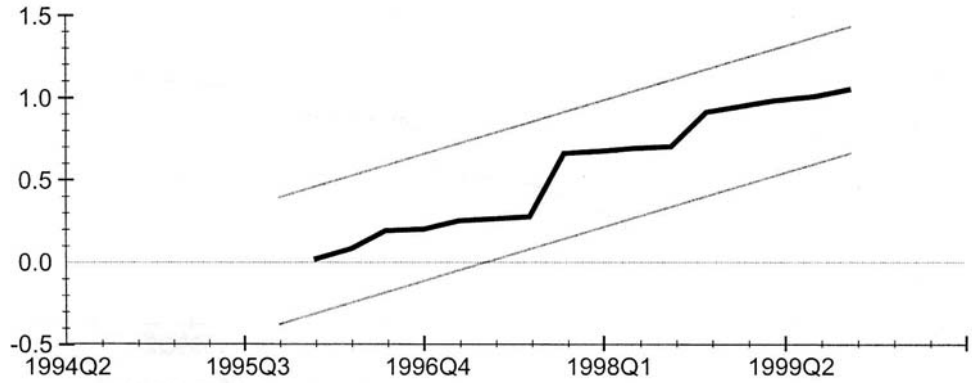
M1 CUSUM TEST STATISTIC



The straight lines represent critical bounds at 5% significance level.

Figure 2

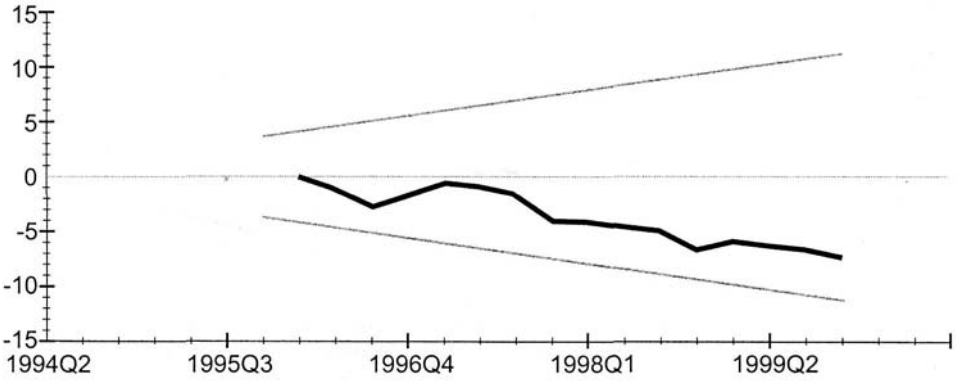
M1 CUSUMSQ TEST STATISTIC



The straight lines represent critical bounds at 5% significance level.

Figure 3

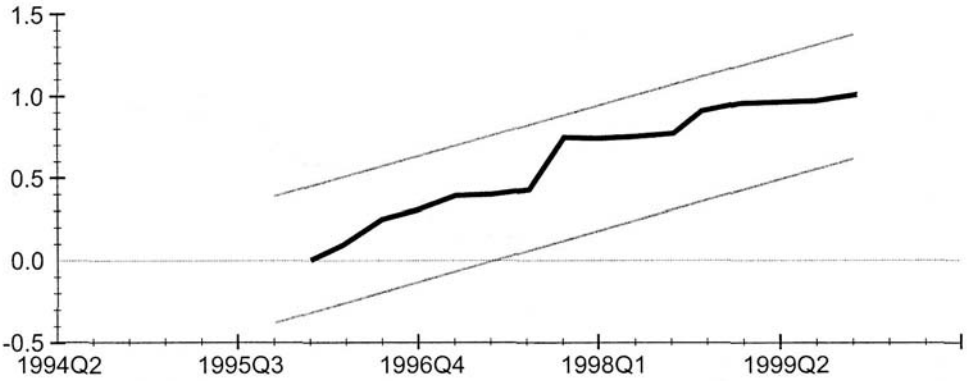
M1A CUSUM TEST STATISTIC



The straight lines represent critical bounds at 5% significance level.

Figure 4

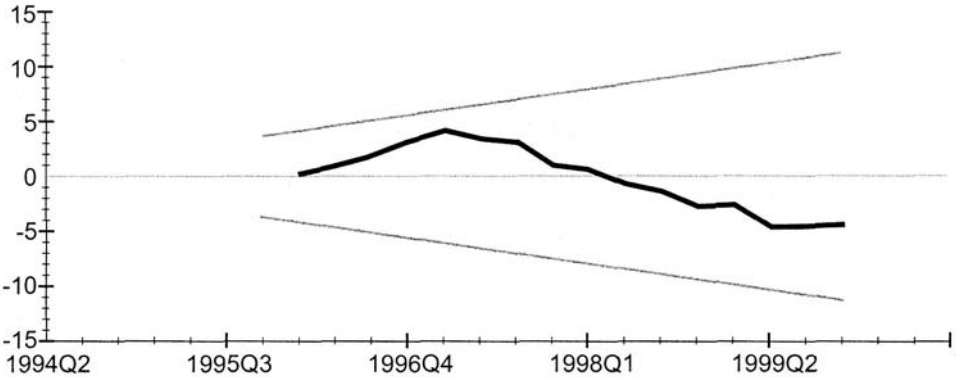
M1A CUSUMSQ TEST STATISTIC



The straight lines represent critical bounds at 5% significance level.

Figure 5

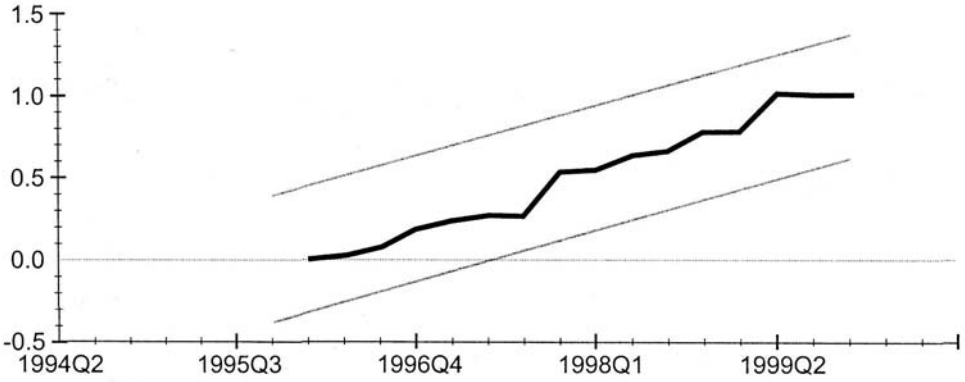
M4 CUSUM TEST STATISTIC



The straight lines represent critical bounds at 5% significance level.

Figure 6

M4 CUSUMSQ TEST STATISTIC



The straight lines represent critical bounds at 5% significance level.

Figure 7

M1 ACTUAL VS. PREDICTED

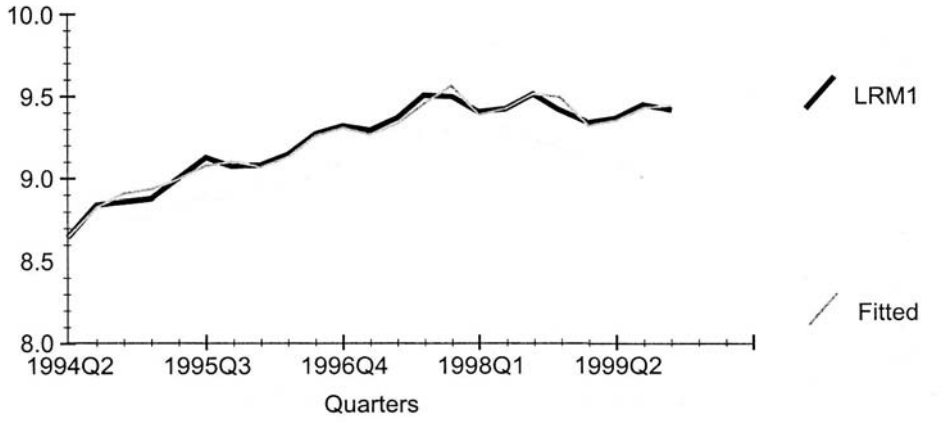


Figure 8

M1A ACTUAL VS. PREDICTED

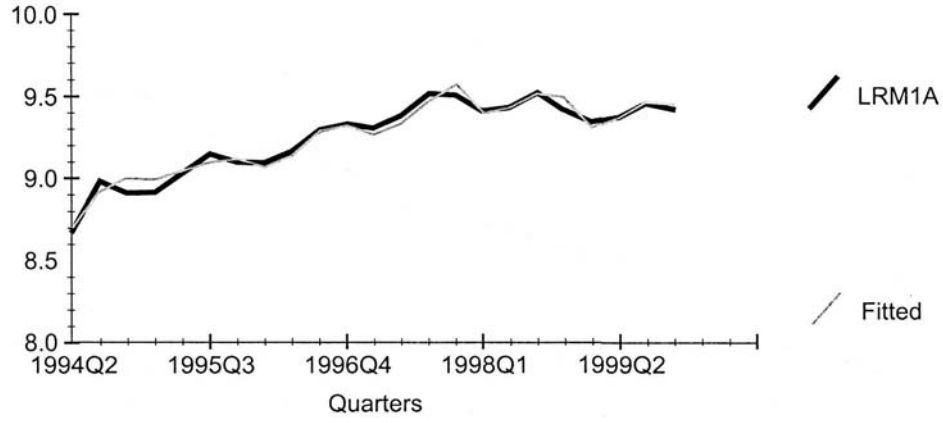
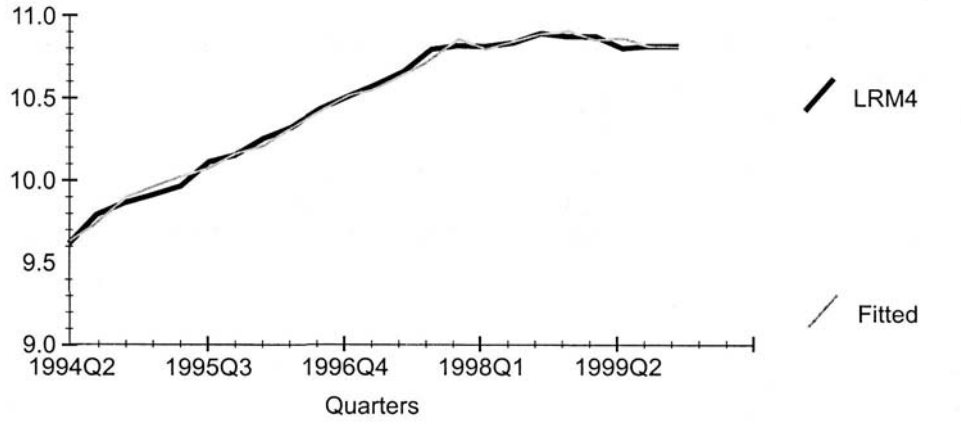


Figure 9

M4 ACTUAL VS. PREDICTED



Appendix A

DATA DESCRIPTIONS

M1 Cash outside banks, deposits with central bank by other banking institutions and other domestic sectors, deposit money banks' demand deposits. Millions of kunas.

M1A M1 plus demand deposits of central government and funds with deposit money banks. Millions of kunas.

M4 M1 plus savings adn time deposits, foreign currency deposits, bonds and money market instruments. Millions of kunas.

i Deposit money banks' interest rates on deposits in kunas, average.

nex Nominal effective exchange rate index, December 1989=100.

rex Real effective exchange rate index, December 1989=100.

y Real GDP. Millions of kunas.

P Retail price index, base 1997=1.0

Appendix B

CORRELATION MATRICES

Real M1:

	ln(M/P)	lny	lni	$\ln(P/P_{t-1})$	lnnex	lnrex
ln(M/P)	1.000					
lny	.9267	1.000				
lni	-.3150	-.3799	1.000			
$\ln(P/P_{t-1})$	.5398	.3940	.0767	1.000		
lnnex	.4122	.5133	-.5639	.0304	1.000	
lnrex	.4225	.5183	-.4795	.0152	.9633	1.000

Real M1A:

	ln(M/P)	lny	lni	$\ln(P/P_{t-1})$	lnnex	lnrex
ln(M/P)	1.000					
lny	.9321	1.000				
lni	-.3397	-.3799	1.000			
$\ln(P/P_{t-1})$	.5576	.3940	.0767	1.000		
lnnex	.4104	.5133	-.5639	.0304	1.000	
lnrex	.4168	.5183	-.4795	.0152	.9633	1.000

Real M4:

	ln(M/P)	lny	lni	$\ln(P/P_{t-1})$	lnnex	lnrex
ln(M/P)	1.000					
lny	.8961	1.000				
lni	-.3613	-.3799	1.000			
$\ln(P/P_{t-1})$	.5216	.3940	.0767	1.000		
lnnex	.5555	.5133	-.5639	.0304	1.000	
lnrex	.5687	.5183	-.4795	.0152	.9633	1.000

POTRAŽNJA ZA NOVCEM U HRVATSKOJ U POSTSTABILIZACIJSKOM RAZDOBLJU: ULOGA TEČAJA I VALUTNE SUPSTITUCIJE

Sažetak

U ovom se radu ocjenjuju uloga tečaja i valutne supstitucije u funkciji potražnje za novcem u poststabilizacijskom razdoblju (od prvoga tromjesečja 1994. do četvrtoga tromjesečja 1999.) za hrvatsko gospodarstvo. Tri različita monetarna agregata, kamatne stope i inflacija pokazali su se statistički nesignifikantnima; ipak, rezultati sugeriraju da je tečaj signifikantan i da ima negativan utjecaj na potražnju za novcem. Ako domaća valuta deprecira, pojedinci će biti skloni supstituirati domaću valutu stranom. Testovi strukturne stabilnosti pokazuju da su ocijenjene funkcije potražnje za novcem stabilne.